49

# The Sidereal Messenger.

CONDUCTED BY WM. W. PAYNE,

Director of Carleton College Observatory.

NOVEMBER, 1886.

CONTENTS:

**By faith we understand that the worlds have been framed by the word of God, so that which is seen hath not been made out of things which do appear.**



**The Messenger will be published monthly except for Aug. and September.**

**Subscription price per year (ten numbers) $2.00.**

**Communications should be addressed to the Editor, Northfield, Minnesota.**

NORTHFIELD, MINN.

CARLETON COLLEGE OBSERVATORY.

Entered at the Post Office at Northfield, Minn., and admitted for transmission through the mails at second class rates.

The Sidereal Messenger,

CONDUCTED BY WM. W. PAYNE,

Director of Carleton College Observatory, Northfield, Minnesota.

VOL. 5, NO. 9. NOVEMBER, 1886. WHOLE NO. 49.

## OUR KNOWLEDGE OF COMETS.*

H. C. WILSON.

Few of the departments of astronomy have been more continuously and carefully studied in the centuries past than the one which pertains to comets, yet none is more interesting today, not only to the astronomer but also to those who occasionally turn their thoughts toward things unearthly. There is something about these wonderful bodies, their vast proportions, the suddenness of their apparition and mystery of their nature, well calculated to arrest attention. In the earlier centuries they seem to have been universally regarded with terror, as harbingers of some dire calamity to mankind;

> "Threatening the world with famine, plague and war;
> To princes, death; to kingdoms, many curses;
> To all estates, inevitable losses;
> To herdsmen, rot; to ploughmen, hapless seasons;
> To sailors, storms; to cities, civil treasons."

Even in the present age the sudden appearance of a brilliant comet, like those of 1881 and 1882, produces a profound impression and causes much speculation concerning its origin, nature and probable purpose.

On an average, about twenty-five of these "blazing stars" become visible to the eye in each century. Many times that number are seen with the aid of the telescope and doubtless many more are beyond the reach of the most powerful "optick

*Address delivered at the University of Cincinnati Commencement for the degree of Ph. D., June 17, 1886.

tubes." Probably the speculation of the illustrious Kepler is true: "That the celestial spaces are as full of comets as the sea of fish, only a small portion of them coming within range of our telescopes."

Let us, with the aid of a powerful telescope, follow one of these mysterious visitors on its journey to the sun and note the phenomena which it may exhibit. It is now about three times the distance of the earth from the sun and appears as a simple round patch of nebulous light nearly uniform in all its parts. It has been traveling for hundreds, perhaps thousands of years through the intensely cold space in the outer parts of the solar system. Gradually the meteoric particles of which the comet is composed begin to glow with increasing light and heat received from the sun, and in the central part, where the light and heat are concentrated by reflection from particle to particle, a condensation appears which gathers intensity from day to day. Finally, a point or disc of light appears in its center which shines with a light approximating that of planets. This is called the nucleus. Later on a faint streak of light or tail is seen extending in the direction opposite the sun. The great majority of comets never get beyond this stage of development, but the one which we now follow is destined to approach very near to the sun and to undergo a degree of heat as intense as that of the cold through which it has recently passed. Swifter and swifter it flies almost straight toward the great center of light, and hotter and hotter become the solar rays. Violent action appears to take place on the sunward side of the nucleus, and great volumes of vapor rise toward the sun with astonishing velocity. Jets are thrown up to the height of thousands of miles in an hour. Sometimes the whole hemisphere of the nucleus appears as one gigantic volcano belching forth an enormous fan-shaped jet of glowing vapor. But what do we see? These jets, after rising toward the sun, fall back, not upon the nucleus but past it on all sides, as if repelled by some force from the sun, and form a hollow cylinder which extends far out into the tail. This hollow cylinder is transparent in the middle portion, like a glass tube, so that it has the ap-

pearance of two bright streams of matter flowing away from the nucleus. The first direction of the cylinder is exactly opposite the sun, but it gradually curves backward, unable to keep up with the nucleus in its ever hastening flight.

Let us pass on and watch the behavior of the comet in the immediate vicinity of the sun. The temperature increases until it becomes 2,000 times hotter than a red hot iron. The nucleus becomes a seething, molten mass in which violent convulsions are taking place, and masses of vapor, and perhaps of molten matter, are ejected with terrific force. But, strange to say, these do not rise to such a height as before. The repulsive force from the sun seems to have proportionately increased and the streams flow away, immediately into the tail. This latter feature expands to an enormous extent and near the head becomes so brilliant as to be visible in midday and close to the sun.

The velocity is now so great that the comet seems about to pass the sun in a straight course and to fly off to the opposite part of the heavens, but here "Old Sol" exerts his powerful arm of attraction and whisks the little nucleus around him with incredible speed and hurls it back in nearly the same direction whence it came. The head of the comet has passed within 300,000 miles of the sun's surface, through, indeed, the very atmosphere of that luminary. Out of this fiery ordeal it comes shorn of everything but the nucleus. The magnificent tail which it possessed but a few hours before has been left behind, to be dissipated in the interplanetary spaces. The smaller particles composing the head, have been completely volatilized and driven away. Streams of matter, however, still issue from the nucleus, even more abundantly than before, and in a few days a new tail is formed more brilliant and of greater proportions than its predecessor. This tail is not behind the nucleus, but in advance and again in the direction opposite the sun. We can watch its growth from night to night, for it is not formed instantaneously, or even with the velocity of light, as many have supposed. It takes from twenty to forty days for the streams from the nucleus to reach the distance at which they vanish.

Sometimes there are condensations in the streams of vapor which may be recognized from night to night, until they reach a distance of a hundred millions of miles from the head of the comet. As they move outward they gradu lly fall back from the straight line, giving to the tail a gracefully curved form. Some of the particles seem to be driven off with greater velocity than others, producing tails of different lengths and different degrees of curvature. One long narrow branch seems to be propelled much more swiftly than the others and is therefore much straighter. Others are extremely faint, very short and greatly curved. The brightest tail extends to a distance of not less than 200,000,000 miles from the nucleus. The thickness of the tail is nowhere less than 100,000 miles, and its greatest width is about 10,000,000 miles. It seems almost incredible that such a vast appendage could be evolved from so small a body, and yet it is so attenuated that the faintest stars may be seen through the thickest portion.

Meanwhile the nucleus has been suffering the effects of the tidal action produced by its close approach to the sun. It must have the tenacity of steel in order to avoid being pulled apart by the tremendous tides, which continue for many days. Soon we find it becoming greatly elongated and in a a few days breaking up into two, three, and many smaller nuclei. As the comet recedes farther from the sun it gradually cools off, the evaporation becomes less abundant, the tail diminishes in size and splendor until all finally disappears, the last aspect being the same as the first: a faint, circular nebulous speck.

In this brief sketch, I have given only those phenomena which I have personally observed in the comets of the last six years. Most of them were exhibited by the one Great Comet of 1882, whose sudden appearance in September of that year, shining in midday close to the sun, startled astronomers themselves. This remarkable object came from the direction of the giant star *Sirius*, moving in an almost straight course towards the sun, swept around that great centre, at a distance of less than 300,000 miles from the sun's surface, with an incredible velocity of a million miles per hour, and is now receding in

almost exactly the same direction whence it came. Its speed is constantly diminishing and at the extreme part of its orbit will be only five miles per hour. The one-half of its revolution around the sun was described in about four hours but the other half will take not less than 750 years.

The origin of comets is still a disputed question. They come from all directions in space and move in very eccentric paths across the sky. Some move around the sun in the same direction as the planets ; others take exactly the opposite course. Some come up from below the ecliptic ; others plunge down from the north polar regions and disappear in the opposite part of the heavens. Still others appear to move straight toward the sun, but suddenly sweep around that great centre, and fly off in the same direction whence they came. Their real paths through space are extremely elongated eclipses, so elongated, indeed, that in most cases they cannot be distinguished from the *parabola* or *infinite* eclipse.

The prevailing opinion is that comets originate outside of the solar system, either as fragments of the original chaotic nebula, out of which the starry worlds were formed, or as having been ejected from the stars and having come by chance within the influence of the sun's attraction ; that the greater number of them simply pass through the solar system and out again never to return ; but that a few happen to pass near some of the planets and are by their attraction drawn into closed orbits around the sun.

The millions of stars which surround us on every side are all remarkably like our own sun. Many of them are even larger and more powerful than he. Reasoning from analogy we may suppose that each of these suns is also attended by comets ; hence we are led to the conclusion that millions of comets, projected forth from millions of suns during countless ages past, are now flying through space in every direction,—restless messengers from star to star. By mere chance some of these must fall within the sun's far reaching power and be drawn into our planetary system.

On the other hand, there are serious objections to this theory,

and some eminent astronomers are arrayed against it. The problem is beset with difficulties and requires for its solution more accurate data than those which we now possess. Practically, for so long a time as history shall last, we may regard them as members of our system, for supposing the sun's power to extend only half way to the nearest star, it would take 10,000,000 years for a comet to pass beyond that limit.

The *physical nature* of these bodies is even more problematical than their origin. The vast proportions which some of them assume, compared with the small quantity of matter which even the largest actually contains, their perfect transparency and the mysterious force by which the tail is driven away from the sun while the nucleus is held firmly in its course, are almost incomprehensible. Recent researches by Professors Newton, Schiaparelli, Zollner, Bredichin and others have thrown much light upon these problems; but we must acknowledge that they are far from satisfactory solutions.

The most probable explanation is that comets consist of small detached particles, partly solid and partly gaseous, so widely separated as to allow the light of stars to pass between them unhindered, and so small that the individual particles cannot be distinguished, but all combined give a continuous light. The nucleus is a dense aggregation of the larger particles, which, perhaps, when near the sun, become fused together and form a planet-like body. The tail is composed of detached particles of vapor and gas, thrown off from the nucleus and the smaller meteoric bodies composing the head of the comet, by an electric force generated in the process of evaporation, and driven outward by an electric force from the sun.

Regarding the influence of comets upon the earth, I may say in conclusion, that they produce no physical effect whatever. There is about one chance in a million that a comet may strike the earth, and if we should happen upon that one chance, the only serious consequence would be a shower of meteors more or less brilliant.

One happy influence they do exert. They excite our curiosity and direct our thoughts to the contemplation of the grand problems of the universe which surround us.—*Carletonia.*

## POPULAR FALLACIES ABOUT OBSERVATORIES.*

MISS MARY E. BYRD.†

During the years that my life has been well nigh lived in an observatory, I have felt that some things are viewed differently by those without and those within the walls. One does not willingly try to dispel pleasant illusions, and yet, since an observatory with all its domes and peers, appliances and instruments, is designed for the search of truth, standing so near its corner stone, I ask your leave to speak the truth frankly for a few minutes.

It has seemed to me, that in the popular imagination, an observatory exists for the purpose of being visited—like a parsonage; or that it is held to be some grand celestial amphitheatre where there are nightly shows of moon and stars and planets, with the astronomer for chief showman; that he delights to exhibit in the fields of his telescope comets' tails, Jupiter's satellites, Saturn's rings and pretty things, much as Barnum likes to show trained elephants and dancing ponies. Now, as a matter of fact, astronomical benevolence does not usually lie along these lines. The observer places a high value on his time, especially the time of clear evenings. Indeed, I fear he is sometimes tempted to say with the poet:

"Who steals my purse, steals trash; but he that filches from me my clear nights, robs me of that which not enriches him and makes me poor indeed." He feels as the Englishman does about his home; his observatory is his castle, and when some clear night he is fairly at work with transit instrument, meridian circle, equatorial or photometer, the casual, unannounced visitor is just about as welcome to him as brigands to the traveler in Spain, or Irish moonshiners to the English landlord, just about as welcome; and if the plain truth were known, not much more so. Now when I build my observatory—it is to be

* Delivered at the laying of the corner stone of the new Astronomical Observatory of Carleton College, Northfield, Minn.

† Assistant in Mathematics and Astronomy.

in California—I invite you all to the laying of the corner stone in 19—. I have fully decided that I shall have a moat and a draw bridge ; about armed sentinels I have not quite made up my mind. On that point I am still willing to be labored with by my more generous-hearted friends. But then if any of you should come, (a friend from Northfield would be so welcome,) I don't doubt you could look through my telescope all night in spite of moat, draw bridge and sentinels.

Almost everyone else has some power in arranging and controlling the time for his work, but the astronomical observer has absolutely no control over the conditions that make his work possible. He cannot make the sky clear, the air steady, or star-disks sharp cut. As a noted astronomer has said : "The work he fails to do to-night, he may wait weeks, months, possibly years, for another opportunity to do ;" so perhaps he is not very unreasonable when he asks only for a chance to do his work.

That word work hardly corresponds with popular ideas. It is commonly fancied that there is a great deal of poetry and romance within the walls of an observatory. All have read the ancient legend of Tycho Brahe, how he went to the observatory in velvet robes of state as if the presence of the stars was the presence of princes. And people fancy that here at midnight, in star-lit domes, you almost hear the music of the spheres. They picture to themselves the observer seated at his telescope, hour after hour, looking down, down into deep lunar craters, feasting on delicate nebulae and swift-flying comets, or reveling in gorgeous star-clusters. Here, they think, night after night before his rapt vision, there passes all the panorama of the heavens, multiplied and glorified a thousand fold by his powerful lenses. I have sometimes wished that it were so, but it is work that goes on in an observatory, work as stern and exciting as that of the factory.

I raise no objection to poetry or velvet gowns, but until some one invents a way of lighting telescopic fields so that the observer is not obliged constantly to handle greasy lamps, the question is not open for discussion ; the bans between poetry

and practical astronomy are positively forbidden. Why, I do not believe even Tycho Brahe himself could have kept grand and stately with grease trickling down his hand! No, the modern observer is mindful of sulphuric acid and sperm oil and dons an old coat, or a shabby dress, as the case may be, and could you look within the walls of the observatory you would not find him idling or dreaming. He moves with a quick, brisk step, casts a hasty glance at the sidereal clock, notes that the batteries are in working order, the electric circuits without breaks, proper connections made, winds the chronograph, puts on the sheet, sets it in motion, and a little later perhaps you see him ready for work with the meridian circle; but it is hardly likely that he is seated in one of those easy observing carriages that you have seen pictured in some advertising page, and set down in your mind as one of the manifold luxuries of an observatory; it is more probable that some home-made contrivance or a mere dry goods box answers his purpose. His hand is on the key, his eye is at the tube, he turns and looks up, but it is with no ecstatic gaze, he is noting the clearness of the sky and the danger from some fleecy clouds near the zenith; again he looks through the glass; there is a succession of short, sharp taps, that means the star is in the field of view: another tap, the star has crossed the first wire of the meridian circle. Then there is a series of taps, microscopes are read and recorded; another setting is made, and then operations may go on for several hours, varied by tying a knot in the chronograph chord, shaking up the stylographic pen, and doctoring the greasy lamp. "And is this all?" you say. "He just puts his finger down there when a star crosses a wire, why a child could do that!" Yes, a child might do it after a fashion, and yet one of our excellent American astronomers, especially skilled in work with the meridian circle, has said it takes years to become proficient in that simple thing. He was too modest to add how much skill and talent were required, and it were better that I left to some one far wiser than I to tell how much of the eternal truth of the stars has been deciphered and brought within the grasp of the human mind

mainly by the exact bisection of a star as it crosses the wires of the meridian circle. And so you might follow the observer from room to room in his work with different instruments, and you would find his duties made up of a large number of petty details, no one of which shows the skill required or the results involved.

Indeed, I think the observer himself is a different sort of personage from that he is commonly imagined to be. He does not dwell constantly in a state of ecstacy or enthusiasm ; he does not require a dictionary of superlatives to express his feelings about the stars; he does not stay up late nights to look at pretty things through his telescopes. He is, perhaps, rather indifferent to merely pretty things, and may shock some entranced visitor by his utter lack of proper emotion over some telescopic spectacle ; but he will spend his nights for weeks and months in painstaking observations, making hundreds of measures of angle and position ; he will give up his days to laborious computation, and all for what ? Why just to find out that two insignificant stars in the heavens, (one of which the unaided human eye will never see), to find out that they form a system, are bound together by the force of gravitation, the one moving in a path about the other in an orbit that he can map. It seems a prosaic result, and yet such truths as that are worth a world more to the earnest observer than years of pleasure hunting in fields sown thick with glittering stars. He is not looking for amusement or beauty, he is seeking the truth, if happily he may find it. He longs to find out, to understand, to know ; back of form and motion and color, he seeks the unchanging varities.

No, it is not to found a palace for dreams, a place where the the fancy may feast on swift-changing star pictures that the walls of an observatory go up. It is to establish a place where truth is sought. I know that there are those who think that an observatory is a monument to human pride and human intellect, and the truth found here appears cold and visionary, without power to warm the human heart or make the world better. To me it seems that God made human minds hungry for all truth and that he says to the observer here, as well as to the disciple of old—"Seek, and ye shall find."

## THE SUPERSTRUCTURE.*

MISS MARY B. CUTLER, CLASS OF '87.

In the midst of the brick and the mortar,
  We pause, with plummet in hand,
To look backward and forward and upward,
  While 'neath heaven's dome we stand—
Back, to the small beginning,
  On, to the plan fulfilled,
Up, to the Masterbuilder,
  Without whom, in vain we build.
But besides this firm foundation,
  Which gives us pride to-day,
There has longer far been building
  A support that will longer stay
Of care and thought and devising,
  Both human and divine,
And labor self-sacrificing,
  These forces to combine.
Upon this rare foundation,
  With our mental vision's aid,
In bricks of imagination,
  With mortar of fancies laid,
There rises a fair superstructure
  All fitted and finished throughout
With the tried foundation substance.
  From its windows, the fields without
Reveal to companies eager,
  While upward their souls are led,
The handiwork of Elohim
  Upon the dark firmament spread.
Its rooms are all abounding
  In instruments of thought,
Their polished and balanced movements
  With skill and cunning wrought;
And yonder's a lofty tower,
  Where, in crystalline splendor, rests
A new thought of God adjusted
  To human use,—and the quests
Of years of patient study
  Have opened, at length, a way

*Delivered at the laying of the Corner Stone of the new Astronomical Observatory of Carleton College, Northfield, Minn.

To wider and deeper searchings
  Than any one knows to-day.
So may the future workers
  Disclose Orion's keys,
And learn the sweet influence
  Of gleaming Pleiades;
In the new revelation,
  Not seven stars only see;
The reward of their overcoming
  The Morning Star shall be.

---

## HYMN.*

PROF. GEO. HUNTINGTON.

Creative Word! whose mandate broke
  The silence of primeval time,
Form, order, beauty to invoke,
  Reverent we wait thy voice sublime.
Formless and void our work must be,
Unless commanded first by Thee.

O Hand of Power! whose skill could frame
  From nought a world so vast, so fair,
Nor skill nor power our hands may claim.
  Make Thou our lowly task thy care.
Not small, not vain that work can be,
Whose least beginnings are from Thee.

O Mind divine! whose power hath wrought,
  In changeful form and changeless law,
The fashion of thy glorious thought,
  Thy shining paths we trace with awe
From height to starry height, and fain
Would think thy glorious thoughts again.

Light Thou our pathways from above;
  Our minds enkindle with thine own;
Till, like thy stars, our thoughts shall move
  In bright procession round thy throne;
Till all our joy and wisdom be
To think, to walk, to work with Thee.

---

*Sung at the laying of the Corner Stone of the Observatory of Carleton College, Northfield, Minn.

## A BLAZING STAR.

About half past 9 o'clock last Friday night (August 20, 1886) the star Zeta in *Cassiopea* appeared to blaze up with unusual brilliancy. It was apparently more prominent than a star adjacent which is rated in the catalogues as being larger by about half a magnitude, and was nearly as bright as the most prominent stars in that well-known constellation. It so continued for almost half an hour, after which it receded to nearly its normal brightness as compared with other stars in the vicinity. At the time of its greatest brilliancy a ray of light, like the tail of a small comet, seemed to shoot out in the direction of Lambda in the same group, taking in the smaller stars numbered as 114 and 118 of *Cassiopea.*

It is high up in the northeast in the evenings of this month, and forms the "chair" or "W" which is described in many of the astronomical text-books as being on the other side of the pole from the big dipper. The star Zeta is the one nearest the upper right hand corner of the diagram, and is the one furthest from the north star.

The phenomenon here described was observed by an astronomer in this city, who noticed it first with the naked eye, only to doubt the evidence of his senses. He looked at it again and again, and finally examined it through a glass, carefully comparing its brightness with that of the other stars within a few degrees of its place in the heavens. It is not known that the appearance has been observed elsewhere, but it would seem strange if it escaped the attention of all other persons who are familiar with the face of the sky. The most singular thing about the phenomenon is the shortness of time that it lasted. The blazing out of a star to much greater prominence than it had hitherto assumed is not a very rare thing, and at least three of these apparitions are recorded as having occurred in this very constellation, around which have been woven the fanciful story of "The Star of Bethlehem." But in these and all other cases the extra brilliancy has continued for a much longer time than that above noted, the period occupying from a few weeks to

several months. The extra prominence in this case may have lasted much longer than half an hour, as its beginning was not observed, but it could not be otherwise than describable by the use of the word ephemeral. It is very difficult to think of a satisfactory explanation of the phenomenon.—*Prof. E. Colbert in Chicago Tribune.*

## THE TANGENT INDEX.

JOHN HAYWOOD.*

For the Messenger.

This summer it occurred to me to develop more fully than I had hitherto done, a method of making clearer to elementary students of astronomy the earth's motion in its orbit. I have been accustomed for many years to give my classes a precept of my own, at least one I have never seen anywhere, though its form was suggested by a rule given in Davis' Manual of Magnetism to enable one readily to determine the directive action of a current of electricity upon a magnetic needle. My precept is this: Conceive the body placed in the meridian and parallel to the earth's axis; with the head to the north; with the face to the sun. Extend the arms to right and left perpendicular to the body. They will represent roughly a tangent to the earth's orbit; and the earth is moving to the right, in its revolution around the sun.

This rule is inexact. Thus the tangent to the earth's orbit is perpendicular to the axis only at the solstices. At the time of the vernal equinox the tangent is depressed below a perpendicular to the axis $23\frac{1}{2}°$. At the time of the autumnal equinox it is elevated above the perpendicular the same amount. That is, this angle, which I call the declination of the tangent, varies from $-23\frac{1}{2}°$ to $+23\frac{1}{2}°$.

It is impracticable to place the body in the position contemplated in the rule above. To assist the class in understanding and applying it, I take two sticks, blackboard pointers, and

* Professor of Mathematics and Astronomy, Otterbein University, Westerville, O.

placing them in the form of a cross, readily bring the combination into the required position, so that one of the rods shall represent the earth's axis, and the other a tangent to the orbit.

Having some leisure this summer, I have constructed the tangent index to exhibit the subject more fully. The first step was to put a mortise through a convenient stick and insert in this another in the form of a cross; but moving on a pivot through a short arc in the plane of the first stick, which represents the axis. The next step was to attach a circle to the axis at the center of the cross with a suitably graduated arc, and an index on the cross piece so that it may be placed at the proper angle with the axis. The third step was to mount this cross on a frame by pivots in the line of the axis upon which it turns; and with the pivot at the north end of the axis resting in a small frame which slides along a graduated vertical arc, to adjust the axis for latitude. The last step was to attach a time circle graduated and numbered to 24 hours, with its index, to one end of the axis; the circle being adjustable for the hour angle of the tangent. By the hour angle I mean the diedral included between two hour circles, one passing through the sun, the other containing the tangent.

To use the instrument, place the axis in the meridian, elevate the north end for latitude, adjust the tangent arm for declination for the date. Adjust the hour angle for the date. Then turn the cross on its axis till the time index points to the local apparent solar time on the time circle. The tangent index is now parallel to a tangent to the earth's orbit, and points in the direction of the earth's orbital motion; that is, eastward along the orbit. It seems to me that this instrument, properly used, will help beginners in the study of astronomy to more definite and satisfactory knowledge of the earth's motions. I expect to test it in my class.

The declination of the tangent is obtained by computation according to these formulæ:

$$\text{Tan } P' = \tan e \cos l.$$

$$\text{Sin } \theta = \sin P' \cos \delta.$$

$\theta$ is the declination sought; $e$ is the obliquity of the ecliptic; $l$ is the earth's heliocentric longitude; $\delta$ is the earth's (or sun's) declination. P′ and $\theta$ have their values always between the limits $-e$ and $+e$. P′ and $\theta$ differ in value only 46′ at the greatest.

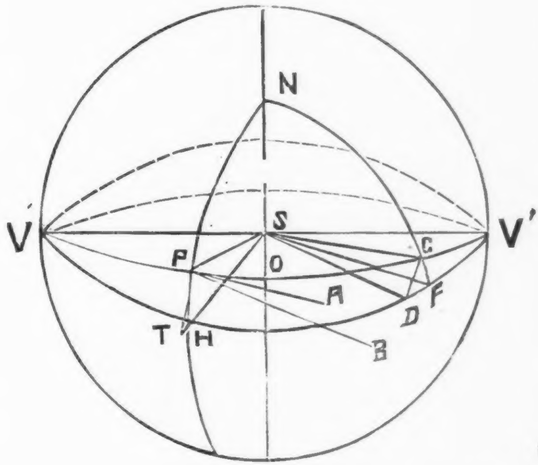
To demonstrate these formulæ, I refer to the accompanying diagram. This represents the celestial sphere. S the sun's center; VOV′ the earth's orbit; V the vernal equinox; VQV′ a great circle parallel to the earth's equator; we will call it the equator, and its secondaries, hour circles. Let P be the earth's position at some time; PA a tangent to the orbit at P, is the direction of the earth's motion at the time. It is assumed to be perpendicular to the radius vector SP. N is the North Pole of the heavens; NPH is an hour circle; PB a perpendicular to NPH at P, and therefore a tangent to a great circle passing through P perpendicular to NP. The angle APB is the complement to the spherical angle P of the triangle VPH. By Napier's rule we have cot P=tan PVH cos VP. Representing PVH by $e$, and VP, the earth's heliocentric longitude, by $l$, and the angle APB by P′, we have tan P′=tan $e$ cos $l$.*

The plane of the angle APB is oblique to the equator. Draw PT tangent to the hour circle NH. The three tangents, PA, PB, PT, are in the same plane, since each is perpendicular to the radius vector SP; and the angle PTS, the complement of PSH, is the angle of the diedral. Draw SC parallel to PA; this line is in the plane of the earth's orbit. Draw SD parallel to PB; this is in the equator, since PB, being perpendicular to NP, is parallel to the equator. Connect C and D by the arc of a great circle, and draw the hour circle NCF; also draw SF. The angle CSF is the inclination or declination of the tangent PA. Represent this by $\theta$. In the right spherical triangle CDF, the angle D is equal to PTS, which is the complement of PSH, the earth's declination. Call this declination $\delta$. Then CDF=90°—$\delta$. CD measures the angle CSD, which

* This is as far as I had carried the analysis of the tangent declination at the time I exhibited and explained the instrument before Sec. A of the A. A. A. S. at Buffalo this summer.

equals the angle APB=P′. Then by Napier's rule, $\sin\theta = \sin P' \cos\delta$.

The hour angle of the tangent is found by the formula, $\cos(180° - H) = \tan\theta \tan\delta$. To demonstrate this we can make use of the same diagram as in the former case; but it is necessary to change the meaning of some of the lines. Let S be the earth's center; VPV′ the ecliptic, the sun's apparent path; C the sun's place at some time; SC the radius vector; SP perpendicular to SC, be a tangent to the earth's orbit. The




orbit is not represented in the diagram. The apparent motion of the sun is supposed to be towards V′; therefore the earth's real motion is in the direction SP. In the spherical triangle PNC, PC, subtending the right angle PSC, is a quadrant. The arc of the hour circle $NC = 90° - \delta$; $\delta$ is the sun's declination. $NP = 90° - \theta$. The angle PNC is the required hour angle which is represented by H. Then taking the right triangle polar to the quadrantal triangle PNC, solving by Napier's rule, and returning to the triangle PNC, we have $\cos(180° - H) = \tan\theta \tan\delta$. It is seen that when $\delta(CF) = 0$,

the triangle has two sides quadrants, and is bi-rectangular; and H=90°. This occurs at the time of the equinoxes. Also when $\theta$, or PH,=0, in like manner H=90°. This occurs at the time of the solstices. At intermediate times, the value of H varies from a minimum value of 85° 4′ about May 4th and November 6th, to a maximum value of 94° 56′ about February 4th and August 8th.

I add tables of the values of $\theta$ and $H$ for certain dates through the year, at intervals of five days. The numbers in the tables are computed for Greenwich noon of the dates for the quarter March-June. For the remaining three quarters of the year the dates are selected so that the values are correct some hour of the day of date but not at Greenwich noon.

*Table to accompany the Tangent Index. Theta is the Declination of the Tangent. Its sign is given at the head and foot of the column containing the date. H is the hour angle.*

| | $H$ | | | $\theta$ | | | $H$ | | |
|---|---|---|---|---|---|---|---|---|---|
| — | | | + | | | — | | | + |
| March 20 | 90° | 0′ | Sept. 23 | 23° | 27′ | March 20 | 90° | 0′ | Sept. 23 |
| " 25 | 89 | 11 | " 27 | 23 | 22 | " 15 | 90 | 49 | " 18 |
| " 30 | 88 | 21 | Oct. 3 | 23 | 6 | " 10 | 91 | 39 | " 13 |
| April 4 | 87 | 35 | " 8 | 22 | 39 | " 5 | 92 | 25 | " 8 |
| " 9 | 86 | 53 | " 13 | 22 | 1 | " 1 | 93 | 7 | " 3 |
| " 14 | 86 | 17 | " 17 | 21 | 14 | Feb. 24 | 93 | 43 | Aug. 28 |
| " 19 | 85 | 46 | " 22 | 20 | 19 | " 19 | 94 | 14 | " 23 |
| " 24 | 85 | 24 | " 27 | 19 | 13 | " 14 | 94 | 36 | " 18 |
| " 29 | 85 | 10 | Nov. 1 | 18 | 0 | " 9 | 94 | 50 | " 13 |
| May 4 | 85 | 4 | " 6 | 16 | 40 | " 4 | 94 | 56 | " 8 |
| " 9 | 85 | 6 | " 11 | 15 | 13 | Jan. 31 | 94 | 54 | " 3 |
| " 14 | 85 | 17 | " 16 | 13 | 40 | " 26 | 94 | 43 | July 29 |
| " 19 | 85 | 36 | " 20 | 12 | 2 | " 21 | 94 | 24 | " 24 |
| " 24 | 86 | 8 | " 25 | 10 | 20 | " 16 | 93 | 52 | " 19 |
| " 29 | 86 | 34 | " 30 | 8 | 34 | " 12 | 93 | 26 | " 14 |
| June 3 | 87 | 12 | Dec. 4 | 6 | 46 | " 7 | 92 | 48 | " 9 |
| " 8 | 87 | 55 | " 9 | 4 | 55 | " 2 | 92 | 5 | " 4 |
| " 13 | 88 | 42 | " 14 | 3 | 2 | Dec. 29 | 91 | 18 | June 29 |
| " 18 | 89 | 30 | " 19 | 1 | 9 | " 24 | 90 | 30 | " 24 |
| " 21 | 90 | 00 | " 21 | 0 | 0 | " 21 | 90 | 00 | " 21 |
| — | | | + | | | — | | | + |

## EDITORIAL NOTES.

The next number of the MESSENGER will close the current volume. Some changes are contemplated for 1887, which, it is hoped, will give our work a wider range of of usefulness.

THE NEW COMET.—Whilst sweeping the low eastern horizon, on the morning of October 5, with the 5 in. refractor, I found, in an open space between the observatory dome and a large mass of trees, a bright round nebulous object, at about $5h$ mean time. I had scarcely time to reach the observatory and turn the 6 in. upon it when it was lost in dawn ; however, two equatorial pointings were obtained, giving the place of the object:

$$RA = 10h\ 36m\ 8s.$$
$$Decl = +0°\ 58'.$$

at $17h$ $12m$, October 4th, Nashville mean time.

Though positive that it was a comet, yet not having seen it long enough to detect motion, I feared to risk the announcement as a comet but at once gave the usual notification to Dr. Swift of a "suspected comet."

The following morning, Oct. 6, the object was again observed and found to be in motion towards the north-east, seven ring micrometer comparisons with an unknown 9th mag. star were obtained. Dr. Swift was then notified to announce it, which he did, having himself verified the discovery that morning.

The comet has been observed every morning since the discovery and ring micrometer positions obtained.

On the morning of the 6, a faint short tail was seen, pointing approximately away from the sun, and at each observation a small and rather difficult nucleus has been observed. The last two observations show the comet is getting fainter.

My eastern horizon is very bad, cut off to a considerable altitude by trees, and it was while sweeping in a narrow gap that the comet was found. Had it not been seen in this gap it would not have been found by me, for when its altitude is sufficiently great to bring it above the trees it cannot be seen, being blotted out by dawn.

E. E. BARNARD,
Vanderbilt University Observatory,
Nashville, Tenn.

October 9th, 1886.

COMET BARNARD (1886).—A telegram was received at Harvard College Observatory on October 5, from Mr. E. E. Bar-

nard, of Nashville, Tenn., stating that an object, possibly a comet, had been seen by him, and requesting a verification, if possible, on the following morning. The morning of October 6 was hazy at Cambridge, but Prof. Lewis Swift succeeded in finding the object, and the announcement of discovery was accordingly made by telegrams, and by cable message to Europe. The discovery position was: October 4.96, Gr. M. T. R. A. 10*h* 36*m* +1° 58′. On the morning of October 6, a cable message from Dr. Krueger announced the independent discovery of the comet by Dr. Hartwig, with the position: October 5.668, Gr. M. T., R. A. 10*h* 37*m* 24*s*, Decl. +1° 3′. This information was made public through the medium of the Associated Press. On the morning of October 7 a good position was secured by Mr. H. V. Egbert, of Dudley Observatory, which was circulated in this country as the second position. On the morning of October 12 a telegram was received from Prof. Lewis Boss, of Dudley Observatory, giving the orbit as below, which was distributed in this country by telegraph and cabled to Europe.

Eight positions of the comet have been received, five from Albany, which are published by permission of the director of Dudley Observatory, two from Nashville, and one from Harvard College Observatory, published by permission of Prof. E. C. Pickering.

| 1886. | | | | M. T. | R. A. | | | Decl. | | | Observer. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | *h.* | *m.* | *s.* | | *h.* | *m.* | *s.* | ° | ′ | ″ | |
| Oct. 5 | 22 | 34 | 14 | Gr. | 10 | 38 | 06.6 | +1 | 05 | 19 | Barnard. |
| 6 | 16 | 57 | 23 | Ca. | 10 | 40 | 03.79 | 1 | 13 | 24.6 | Wendell. |
| 6 | 22 | 07 | 34 | Gr. | 10 | 40 | 06.84 | 1 | 13 | 43.3 | Egbert. |
| 6 | 22 | 40 | 11 | Gr. | 10 | 40 | 09.6 | 1 | 13 | 44 | Barnard. |
| 7 | 22 | 11 | 08 | Gr. | 10 | 42 | 10.42 | 1 | 22 | 14.4 | Egbert. |
| 8 | 21 | 28 | 36 | Gr. | 10 | 44 | 12.83 | 1 | 31 | 00.8 | Egbert. |
| 9 | 21 | 42 | 04 | Gr. | 10 | 46 | 22.16 | 1 | 39 | 43.9 | Egbert. |
| 10 | 21 | 59 | 17 | Gr. | 10 | 48 | 34.66 | +1 | 49 | 14.1 | Egbert. |

From the mean of the Egbert and Barnard positions of October 6, and the Albany positions of October 8 and 10, Prof. Lewis Boss has computed the following elements and ephemeris, received to-day by telegraph:

ELEMENTS.

$T$ = December 11.40, Greenwich M. T.

$$\pi - \Omega = 89^\circ\ 26'$$
$$\Omega = 135\ \ 39$$
$$i = 106\ \ 15$$
$$\log.\ q = .5974$$

EPHEMERIS FOR GREENWICH 12$h$.

| | R. A. h. m. s. | Decl. ° ′ | Light. |
|---|---|---|---|
| November 1 | 11 51 27 | +6 40.5 | |
| 2 | 11 55 31 | 6 59.5 | |
| 3 | 11 59 44 | 7 19.2 | |
| 4 | 12 4 7 | 7 39.4 | |
| 5 | 12 8 41 | 8 0.5 | 5.56 |
| 21 | 13 25 12 | 23 20 | 14.2 |
| December 7 | 17 0 32 | 33 39 | 22.1 |
| 23 | 19 29 2 | 10 40 | 10 2 |

Light at discovery = 1.

COMET FINLAY.—This comet was discovered by Prof. Finlay, September 26, at the Cape of Good Hope. It was about one minute of arc in diameter, circular and faint, slight central condensation, no tail. The following elements were computed by Prof. Lewis Boss:

$T$ = 1886, November 20.989

$$\left.\begin{array}{lrr} \omega & 301^\circ & 25' \\ \pi & 352 & 51 \\ \Omega & 51 & 26 \\ i & 3 & 20 \end{array}\right\}\text{App. Eq.}$$

$$\log.\ q\quad 0.05866$$

Middle Place (C—O).

$$\Delta\lambda \cos.\beta = +0'.9$$
$$\Delta\beta = -9'.4$$

From *Science Circular* No. 72, we also take the following :

In my communication of October 2, I intimated that I would prepare an ephemeris of the Finlay Comet based on the theory of its probable identity with Comet 1844 I., but an examination of the case shows that the elements of the Di Vico Comet have undergone considerable perturbations, and that

an ephemeris based upon them and adjusted to fit the four observations now at hand (which are barely more than approximate) would be entitled to scarcely more confidence than that which is presented below in continuation of that published in the *Science Observer* circular of October 4.

EPHEMERIS.

| Greenwich 12*h* | | R. A. *h.* *m.* *s.* | Decl. ° ′ | Light. |
|---|---|---|---|---|
| 1886 October | 25 | 18 30 04 | —26 30 | 1.7 |
| | 27 | 18 37 33 | 26 23 | 1.7 |
| | 29 | 18 45 12 | 26 15 | 1.7 |
| | 31 | 18 53 02 | 26 05 | 1.8 |
| November | 2 | 19 01 01 | 25 53 | 1.8 |
| | 4 | 19 09 10 | —25 38 | 1.9 |

Dudley Observatory, Albany, N. Y., Oct. 11, 1886.
—*Professor Lewis Boss in Science Observer (Circular No. 72).*

HITHERTO UNRECOGNIZED WAVE-LENGTHS.— In 1884 Professor Langley published a paper giving a description of a method of measuring wave-lengths in the solar spectrum as far as about 23,000 of Angstrom's scale. At this point the study greatly increased in difficulty, either by prism or grating, making it desirable, if not necessary, to devise new apparatus, that thereby any observer might determine the visible and invisible wave-lengths of any heat, whether from terrestrial or celestial sources, by the use of the prism and gain a knowledge of the intimate constitution of radiant bodies, which is now only known by a study of the vibratory periods of their molecules.

For description of the new apparatus and the detailed study of observations, reference must be had to Professor Langley's paper. In closing he says:

"Broadly speaking, we have learned through the present measures, with certainty, of wave-lengths greater than 0.005 of a milimeter and have grounds for estimating that we have recognized radiations whose wave-length exceeds 0.03 of a milimeter, so that we have directly measured to nearly eight times the wave-length known to Newton ; we have probable indica-

tion of wave-lengths far greater, and the gulf between the shortest vibration of sound, and the longest known vibration of either is now in some sense bridged over."

---

STANDARD OF AMERICAN ASTRONOMY.—The standard of American astronomy is high. Noble work has been, and is being, done in every department of the science in this country. Alvan Clark & Sons of Cambridgeport, Mass., have made the world's largest refracting objective; the young firm of Warner & Swasey, Cleveland, Ohio, are mounting it. Mr. Burnham of Chicago is the referee of European double star observers in questions of dispute, and his catalogues of double stars are authority everywhere. Professor Young's "The Sun" epitomizes present knowledge of solar physics as the work of a leading discoverer and an astronomer of rare insight; Professor Hall's studies of stellar parallax and the difficult satellites of the planets are unrivaled; Professor Newcomb's astronomical papers, including that one on the velocity of light, are of great merit, however the world's physicists will not forget the skill of Michaelson in this American triumph. Professor Hill's researches in the Lunar Theory are widely known. "Acta Mathematica" of Stockholm quotes from his paper on the motion of the lunar perigee for its late prospectus and sample sheet for English readers. Professor Pickering leads in photometry, Chandler in the computation of comet orbits, Brooks and Barnard in comet discovery, while Dr. Gould's work in the southern heavens, Dr. Peters' star charts, and Dr. Elkin's measures of the *Pleiades* with the heliometer are not less important elements in the high standard of American astronomy. This standard is not without the idea of a Supreme Being in it who is fittingly and reverently recognized by many whose names appear above; but there are some who tarnish it by slur and ignorant innuendo in reference to sacred things that ill becomes the common sense of piety belonging to common people, to say nothing of that which is supposed to belong to true American scholarship.

ASTRONOMISCHEN GESELLSCHAFT.—In the third part of the *Astronomischen Gesellschaft* for 1886, just received, is contained brief biographical sketches of Andreas Hohwu, who died Sept. 28, 1885, at Amsterdam, at the age of 83; Julius Houel, professor of pure mathematics from the faculty of science at Bordeau, whose death occurred June 14, 1886; and Gustav Adolph Richard Maywald, who died July 19, 1886. Wilhelm Schur's article containing the results of pendulum determinations at various points with reductions, is noteworthy.

E. Schoenfeld, one of the editors, reviews at length the papers entitled "The Zodiacal Light" and "The Apparent Position of Zodiacal Light," published by Arthur Searle of Harvard College Observatory within the last two years. Among other papers, Fr. Deichmuller notices D. P. Todd's preliminary account of a speculative, practical and telescopic search for a trans-neptunian planet which were published in Vols. 20 and 21 of the *American Journal of Science.*

---

EXTENSION OF ASTRONOMICAL RESEARCH.—Recently Professor Pickering has published a pamphlet suggesting a plan for the extension of astronomical research. The scheme makes Harvard College the centre of operations, and the depositary of all funds which may be contributed for this purpose, to be disbursed to competent observers and observatories with suitable instruments choosing to co-operate in one general system of astronomical investigation. This plan is thought to be wise because it will put at work idle observers and instruments in systematic way, which now contribute little or nothing to the progress of astronomy.

A plan, looking in the same direction, for equatorial work only, has been in the mind of Professor Holden since he began to direct the construction of the Lick Observatory in California, except that he asks or expects no contribution of money to carry it out. His words are "We mean to put the large telescope (36-inch clear aperture) at the disposition of the world, by inviting its most distinguished astronomers to visit us, one

at a time, and by giving to them the use of the instruments at certain specific hours of the twenty-four. In this way we hope to make the gift of Mr. Lick one which is truly a gift to science, and not merely one to California and to its University."

*Science* commends Professor Pickering's plan generously and criticises Professor Holden as "hard-pressed to devise" his, implying that the Lick Observatory is short of funds to offer anything better.

Now, we beg *Science* not to plunge these two great observatories into war, for it does not need the skill of a prophet to foresee that such a calamity will certainly build up a great school of practical astronomy, midway between them, where one is already founded at the new observatory of Carleton College, which has the promise of instruments better than one of them, and expects an observing corps superior to the other, with ample funds to maintain both.

---

THE RED SPOT ON JUPITER.—I was much surprised on reading Prof. Hough's remarks in the SIDEREAL MESSENGER for June that the Chicago refractor shows a "narrow line of light" separating the red spot from the dark belts on its southern side. Large telescopes have hitherto been chiefly quoted in attempts to prove that small instruments exhibit too much detail, and it is quite a novelty to hear that the Chicago lens has at last revealed a feature which has eluded detection with less pretentious means.

It is, however, very unfortunate that this achievement is directly negatived by a large number of observations obtained in this country. And Prof. Hough entirely fails in his endeavor to explain the difficulty on the assumption that the telescopes and powers used by English observers are too small to exhibit the detail in question. He curiously avoids the fact that Mr. N. E. Green has been closely studying the disputed features with an 18-inch reflector and that the Rev. I. I. M. Perry has been similarly occupied with an 18½-inch reflector. In April, not a vestige of any bright line was traced separating the spot

and S. belts. The outline of the spot remained definite, it is true, but the belts run right up to it and the obvious difference in tint enabled the margin of the spot to be readily distinguishable. Probably the latter object envelopes the belts in this region for the longitudinal extremities of one of the belts are distinctly visible, though the middle section appears interrupted by the projection of the spot upon it.

A large number of English observers, using telescopes ranging from 3¾ inches up to 18½ inches have, on my suggestion, critically examined Jupiter and the region of the red spot. High powers have occasionally been employed when the seeing was good. I have sometimes used 475 in my 10-inch reflector. In every instance the evidence has been the same, viz: that there was no bright division between the spot and belt.

Probably the two features are not physically associated, being situated at different heights in the Jovian atmosphere, but visually, the spot and belt were joined without the semblance of any bright line of demarkation.

I fear Prof. Hough will scarcely be able to substantiate his observation in the face of the mass of observations, published in the *Observatory* and *English Mechanic*, by which he is opposed.

W. F. DENNING.

Bristol, June, 1886.

---

SOLAR ECLIPSE OF 1886—The total solar eclipse of this year (August 28-29) was observed at Grenada Carriacou, and other points with unexpected success. In the European expedition were some well-known astronomers, as Tacchini, Lockyer, Maunder, Schuster and Perry. As usual, four lines of work were attempted with encouragement in all, if preliminary reports are trustworthy. They were as follows: 1. New facts; 2. Testing of old views; 3. Use of new instrumental methods; and 4. Records of general phenomena.

Under the first head, it is reported that Professor Tacchini found that the solar prominences viewed during the eclipse and after it, under these different conditions and by means of diff-

erent methods were not the same ; that the 'white' prominences, seen in 1883 at Caroline Island, were of the same character as those seen during the eclipse, and that these new phenomena are simply the descent of cooler material. If true, this is important as establishing the direction of solar currents.

The different appearances of the prominences during totality and after it arise from seeing only part of the phenomena in the latter case, that being the central portion of the prominence seen during totality.

The "flash" of bright lines, which has lately puzzled observers so much, is attributed to a "reduction in the intensity of the light reflected by the earth's atmosphere allowing the spectrum of the higher regions to be seen at the moment the lower stratum of the corona was covered by the moon."

The view that the corona may be photographed at any time was not supported, but that appearances on the plate thought to resemble the corona are due to glare only.

In the use of instruments the aim was to take a larger number of photographs than usual, increase the size of the image at the same time, by using larger lenses and secondary magnifiers. This change seemed to turn out well.

By the old methods of work about twenty photographs were taken, five being of the chromosphere and the lower regions of the corona. The official report of this work will be looked for with great interest.

---

ARMAGH CATALOGUE OF 3,300 STARS.—As early as 1828, observations to re-determine the places of Bradley's stars was undertaken at the Armagh Observatory, then under the direction of Dr. Robinson. Preceeding 1854, the places of 5,345 stars had been observed and were published in 1859 (Dublin), and have since been known as the Armagh Catalogue. The book before us is the *Second Armagh Catalogue* of 3,300 stars for the epoch of 1875, deduced from observations made at the above-named observatory during the years 1859 to 1883, under the direction of the late Dr. Robinson, and prepared for publication by his successor, Dr. J. L. E. Dreyer.

The catalogue is in the usual form. Column 1, giving the number of the star. 2. Leland's No. 3. Magnitude from Durchmusterung, Bessell and Argelander. 4. Mean R. A. for epoch. 5. Epoch. 6. Number of observations. 7. Annual precession. And then follows a similar arrangement for N. P. D., and a column of authorities finally. Proper motion is not taken into account. Under the head of "Accuracy of the Results," Dr. Dreyer has made a careful and instructive comparison of the Glasgow and the Armagh Catalogues. Also the Glasgow and this, and a reduction of this to Auwer's Fundamental System.

---

A NEW ASTRONOMICAL OBSERVATORY is being erected at Carleton College, Northfield, Minn. The building is eighty by one hundred feet in size, of St. Louis pressed brick trimmed with Bayfield brown stone. Portions of it are two stories high surmounted by two hemispherical domes of steel, made by Messrs. Warner & Swasey, of Cleveland, Ohio.

The corner stone was laid, with appropriate public exercises, Saturday, October 2, a most beautiful day, in the presence of a large assembly of people. The following was the order of exercises:

Music.

Prayer - - - - - - - - - - - Rev. E. M. Williams.

Music.

Associations of Old Observatory and Students' hopes for the New - Albert C. Finney.

Poem - - - - - - - - - - - Miss Mary B. Cutler.

Paper—Popular Fallacies About Observatories - - - - Miss Mary E. Byrd.

Statements—General and Financial - - - - - - Pres. Jas. W. Strong.

Address and Laying of the Corner Stone - - - - - Prof. Wm. W. Payne.

Singing of an Original Hymn - - - - - Written by Prof. Geo. Huntington.

Benediction.

---

ASTRONOMY IN 1885.—The annual record of astronomy for 1885 was prepared for the Smithsonian report of that year by William C. Winlock, assistant astronomer at the Naval Observatory, Washington, D. C., and has been issued before-hand in pamphlet form. It is the best brief statement of the year's work in all departments of astronomy that we have seen from any source.

COMET ORBIT MODELS.—Prof. William Harkness, of U. S. Naval Observatory, not long ago kindly showed us some models of comet orbits made by himself, for the purpose of presenting to the eye, at a glance, the elements of an orbit, or its position in space. In some cases it is not an easy task for an experienced astronomer to imagine just how the path of a comet lies in space from the numerical values of the elements. The scheme above referred to is simple, neat and very useful. We are glad to add that Prof. Harkness has consented to write out and explain a set of rules for making these comet-orbit models, for the MESSENGER, so that any amateur may do the work for himself.

---

Measures of the double star preceding *Beta Capricorni*.

| Date. | P. | S. | Mag. | T. | Power. |
|---|---|---|---|---|---|
| 1886.701 | 108.7° | 0.81″ | 6–9 | 19.8*h* | 925. |
| 1886.750 | 110.5 | 0.85 | 6–9 | 20.5 | 925. |
| | | MEAN. | | | |
| 1886.725 | 109.6° | 0.83″ | 6–9. | | |

The measures by Mr. S. W. Burnham, published in the SIDEREAL MESSENGER for September, 1884, are :

| P. | S. |
|---|---|
| 108.6° | 0.86″ |

From which it would appear that there has been no appreciable change during the past two years.

Owing to the low altitude of the star, measures are difficult, unless the seeing is good. H.

---

SWIFT'S NEW NEBULÆ.—*Astronimische Nachrichtere* No. 2,746 contains Dr. Swift's third catalogue of one hundred new nebulae. Since, he has sent the fourth catalogue of one hundred, and is now at work on the fifth, having already found a number of new nebulae for it, besides a list of fifty yet unidentified. His 16-inch Clark equatorial is doing royal service for astronomy in this neglected field.

General Catalogue No. 4,594.—This nebula is described as v F in the General Catalogue. I marked it on my chart, some four years ago, as v v F with the 5-inch telescope, under fairly good conditions of seeing and altitude. I find it now almost bright, certainly not faint. It is moderate in size, round v g b M with some small stars grouped about it. Its brightness is a little less than that of the cluster G. S. 4590 in same field with it. Observed May 28 and June 4.

E. E. BARNARD.

---

Remarkable Comet Discoveries.—The discovery of three telescopic comets by Professor Brooks, within one month in 1886, is certainly the most remarkable comet-observing in the history of astronomy. It is also true that two of these were found within a period of four days, giving to this diligent student of the skies four comets in succession and five since August 31, 1885; three of which were visible at the same time.

Professor Brooks has now discovered nine comets in all.

---

Chabot Observatory.—This new observatory is located in Lafayette Square, Oakland, California. Its geographical position is

Latitude, 37° 48′ 5″
Longtitude, $3h\ 0m\ 54.3s$ west

from Washington.

The observatory building with its fine equipment of instruments, consisting of an 8-inch equatorial telescope with circles, driving clock, spectroscope, micrometer, a transit instrument with aperture 4⅛ inches, a sidereal and a mean time clock, chronometer, chronograph, and meteorological instruments, all of the most modern and approved construction, was the gift of Anthony Chabot to the Board of Education in trust for the City of Oakland.

Charles B. Hill and Charles Burckhalter will be connected with the observatory, and F. H. McConnell is in charge of the clocks. The director is F. M. Campbell.

MARSHALL D. EWELL, of Chicago, has purchased a 6¼ equatorial by A. Clark & Sons, and is fitting up a small observatory for astronomical work. Astronomy ought to rejoice when a man of ability enters its fields of labor.

---

GREEN AND BLUE STARS.—For some time past Mr. Charles L. Woodside has been at work on a catalogue of blue stars, and also one of green stars. These may be ready for publication soon.

---

BROCKWELL OBSERVATORY. — Recent intelligence from Lewisburg, Pa., informs us of further generous gifts of Mr. Brockwell to the university at that place, which bears his name. This time it is $10,000, to build an astronomical observatory. It is expected that the observatory will be ready for use in June, 1887.

---

J. C. HOWVER, of Auburn, California, has a 7-inch aperture telescope, and he is beginning astronomical work in a limited way. The mounting was done by himself.

---

J. E. KEELER, who has charge of the time service at the Lick Observatory, uses a 4-inch Fauth transit instrument for observation. Messrs. Warner & Swasey, of Cleveland, have furnished the observatory a fine electrical control chronograph and a mounting for a 6½-inch objective.

---

JULY AURORA.—A brilliant aurora was visible here last night, a rather unusual occurence at this season. First appearance about 10*h*. A low arch, rising and brightening to an altitude of 25 degrees and extending 90 degrees or more in azimuth. Brilliant streamers shooting up to a height of 45 degrees, some above Polaris, continued from 10*h* 25*m* till nearly 11*h*.

The greatest activity occured at about 10*h* 35*m*, diminishing from then to end of display at 11*h* 30*m* or thereabouts. A light green tint was perceptible in the brighter portions.

Hartford, Ct., July 28, 1886. W. C. P.

WINNECKE'S PERIODIC COMET.—This comet is being observed here every night, for position with the ring micrometer on the 6 in. Cook equatorial.

The comet was first seen here on Oct. 16, the sky having been cloudy previous to that date. On the above date the comet was swept up low in the southwest with the 5 in. and was supposed at first to be a new comet, as Winnecke's had for the time been forgotten.

The comet is about 1′ in diam., round and gradually brighter in the middle to an ill-defined nucleus. It is between the 9th and 10th magnitude. Very little time is given to observe it as it sets soon after the sky gets dark enough to see it.

E. E. BARNARD.

## BOOK NOTICE.

A Manual of Land Surveying, comprising an elementary course of practice with instruments and a treatise upon the survey of public and private lands, prepared for the use of schools and surveyors, by C. F. K. Bellows, M. A., C. E., professor of mathematics in the Michigan State Normal School, and F. Hodgman, M. S., C. E., practical surveyor and engineer. Pp., 364; tables, 100. Neat, flexible cover.

The motto of this hand book is, "Let things that have to be done be learned by doing them;" a good precept certainly, to guide in giving instruction in this branch of study. Every teacher of surveying, who expects his pupils to have any practical knowledge of the branch, knows full well that such knowledge is gained only by actual use of the instruments in the field.

The first section gives a review of the trigonometry necessary to the branch, then follows a description of all the varied instruments in common use, with illustrations and problems for each in accordance with useful practice. The sections on Leveling, Drainage, Surveying, Original Surveys, Re-surveys, Lost corners, and miscellaneous matter are especially helpful. Tables of logarithms, natural sines, tangents and secants and logarithmic sines and tangents, traverse tables, etc., conclude the volume. The book contains what the practical surveyor needs to know and omits much useless matter often found in such hand-books.

XUM